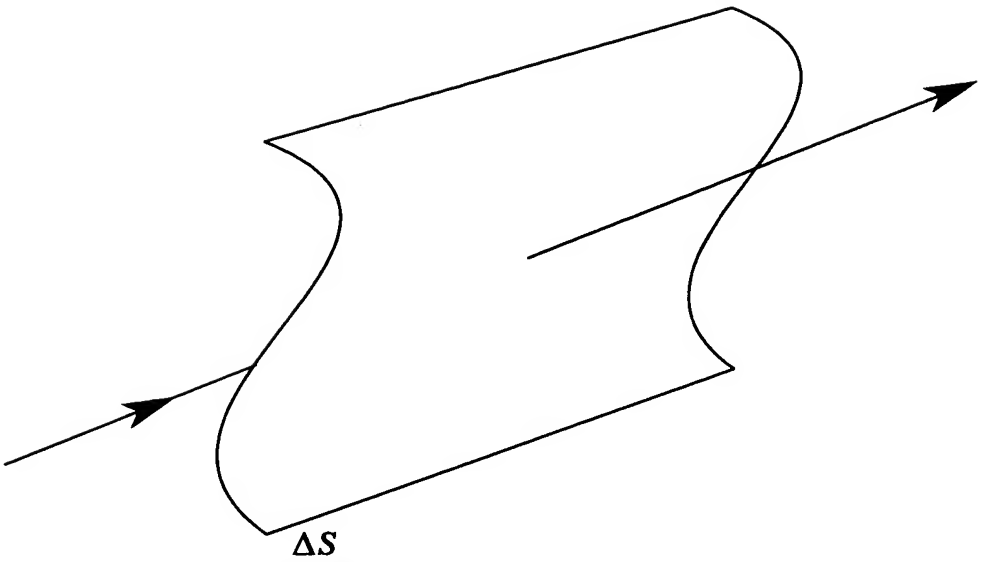
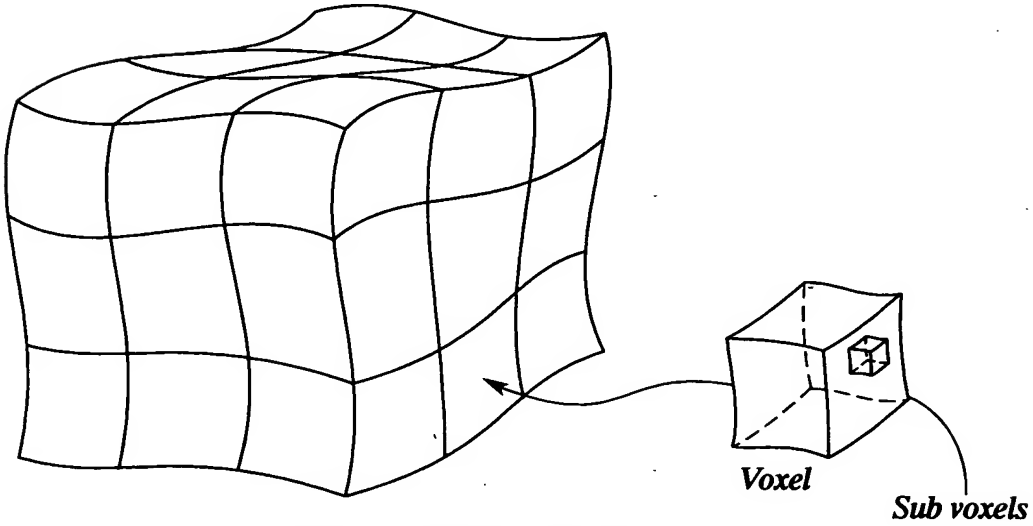


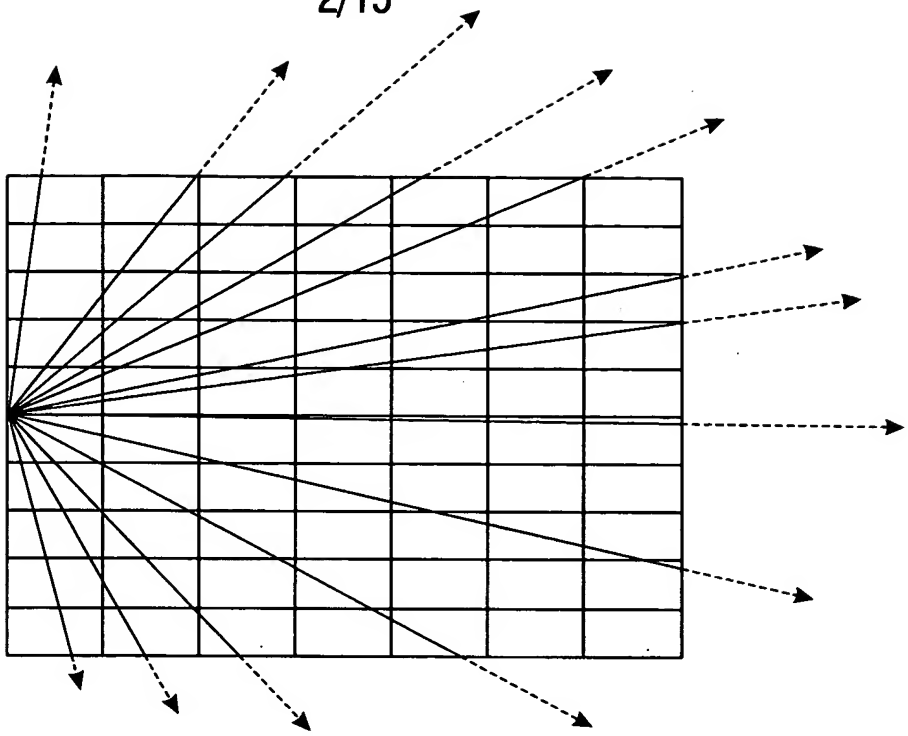
Real Single Particle Passing Thru Finite Surface ΔS

Fig.1



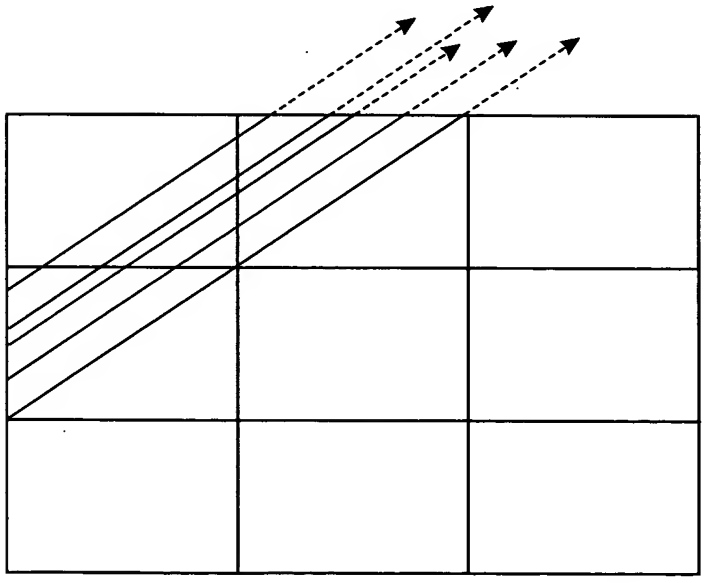
Small Grid System of Voxels

Fig.2



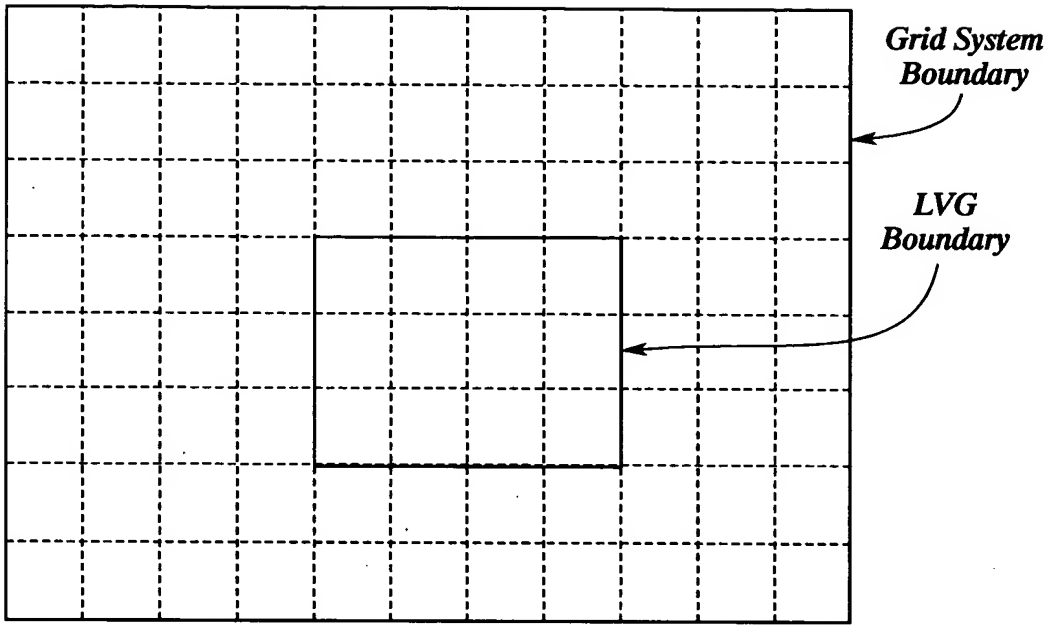
Subset of Rays Traversing 2D Grid System from Reference Surface

Fig.3



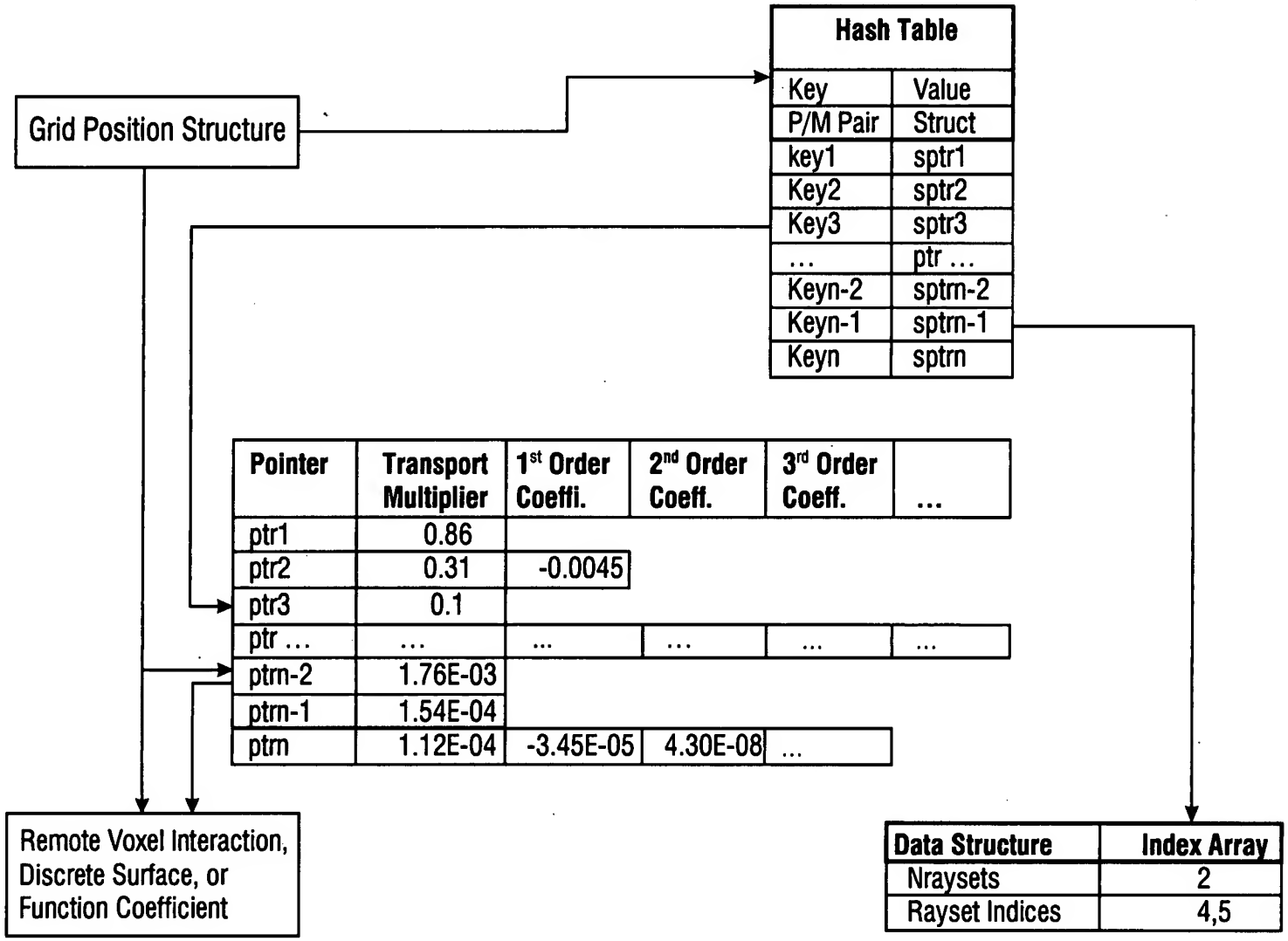
Rays within a particular Ray Set $\Delta\Re$ from a Reference ΔS Occupying Solid Angle Group $\Delta\Omega$ Traversing Voxels

Fig.4



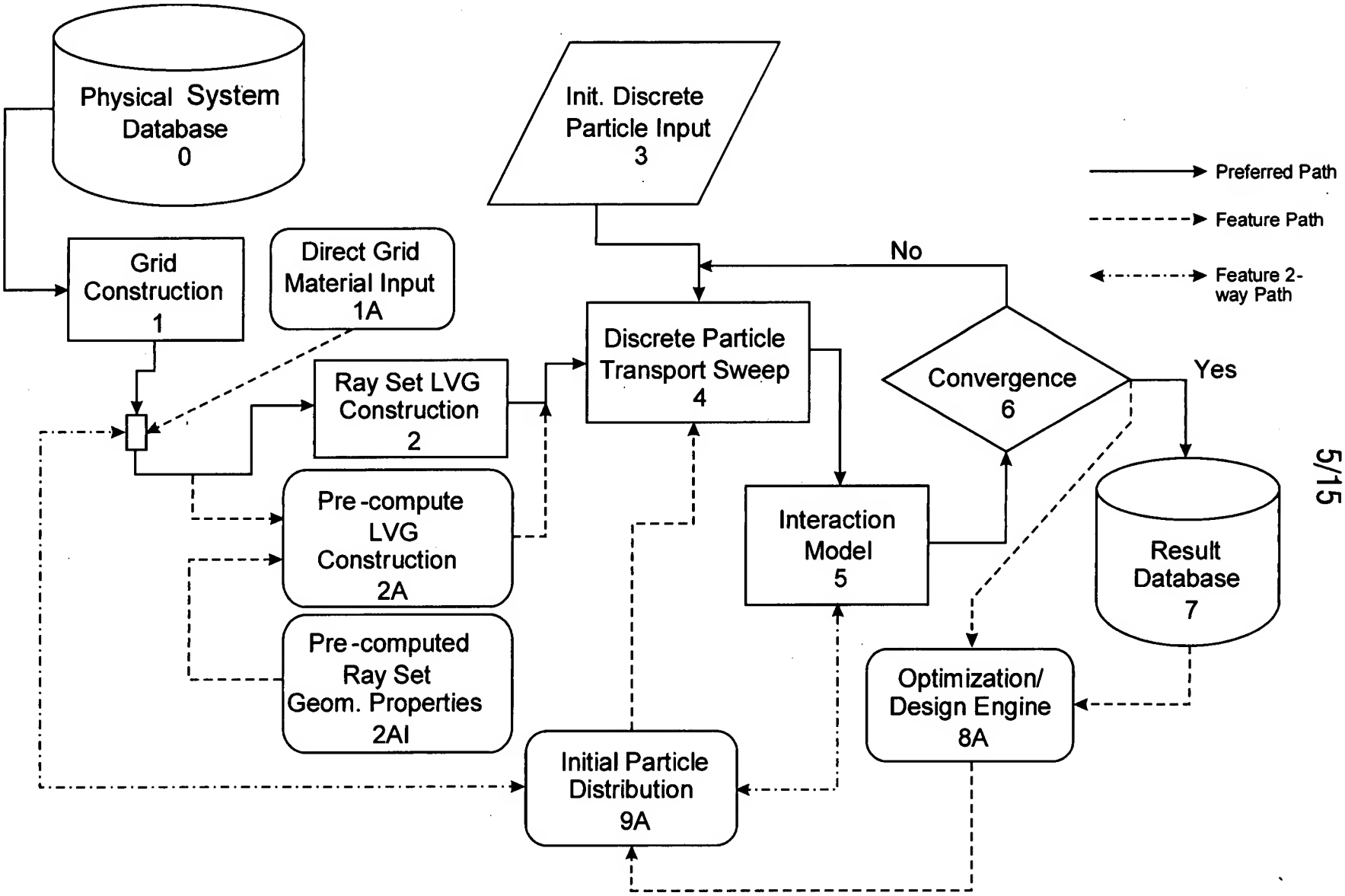
An LVG From A Reference Voxel Surface 2D or Overhead View

Fig.5



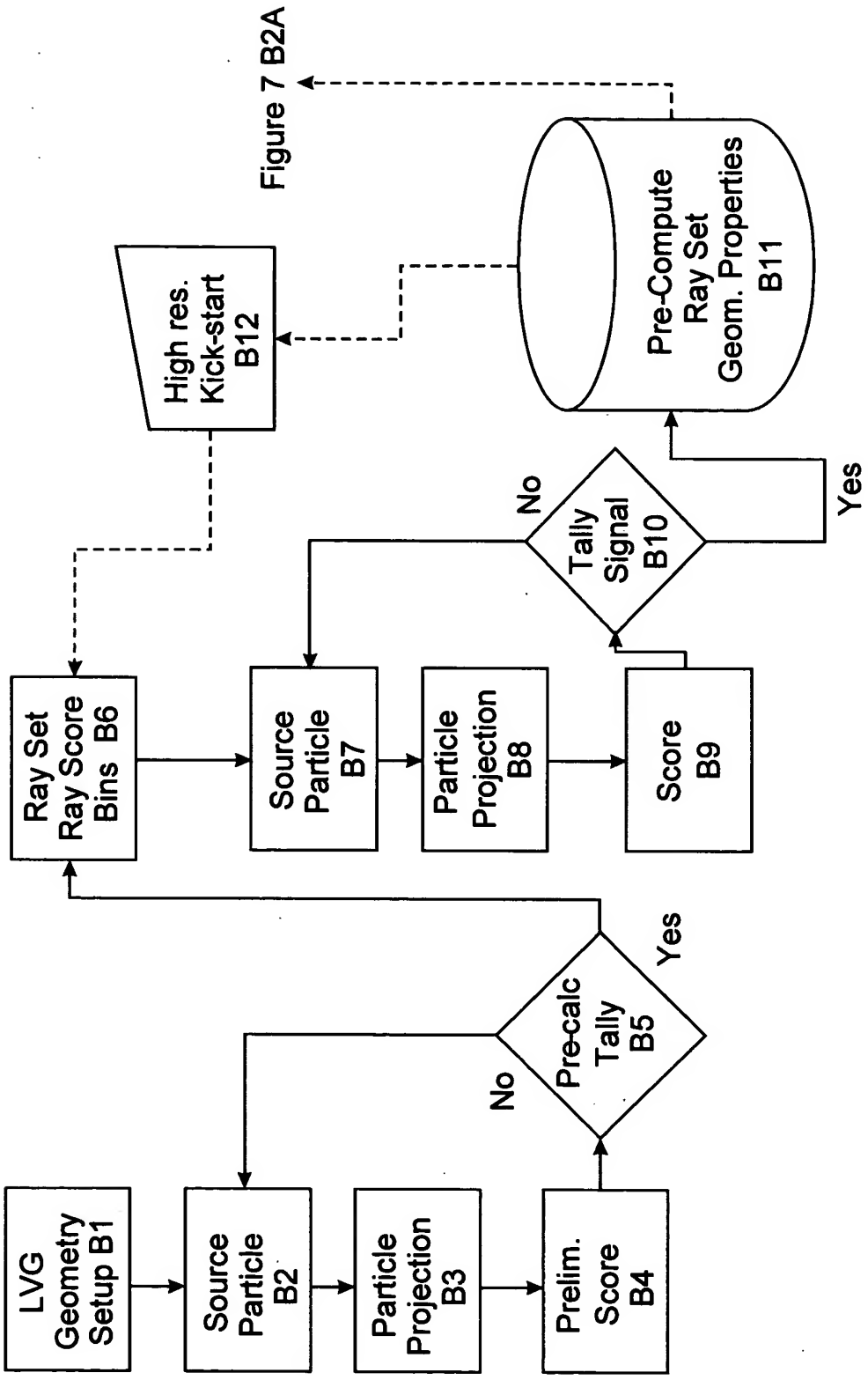
Pointer/Transport Multiplier Memory Device

Fig.6



Invention Process Block Diagram

Fig. 7



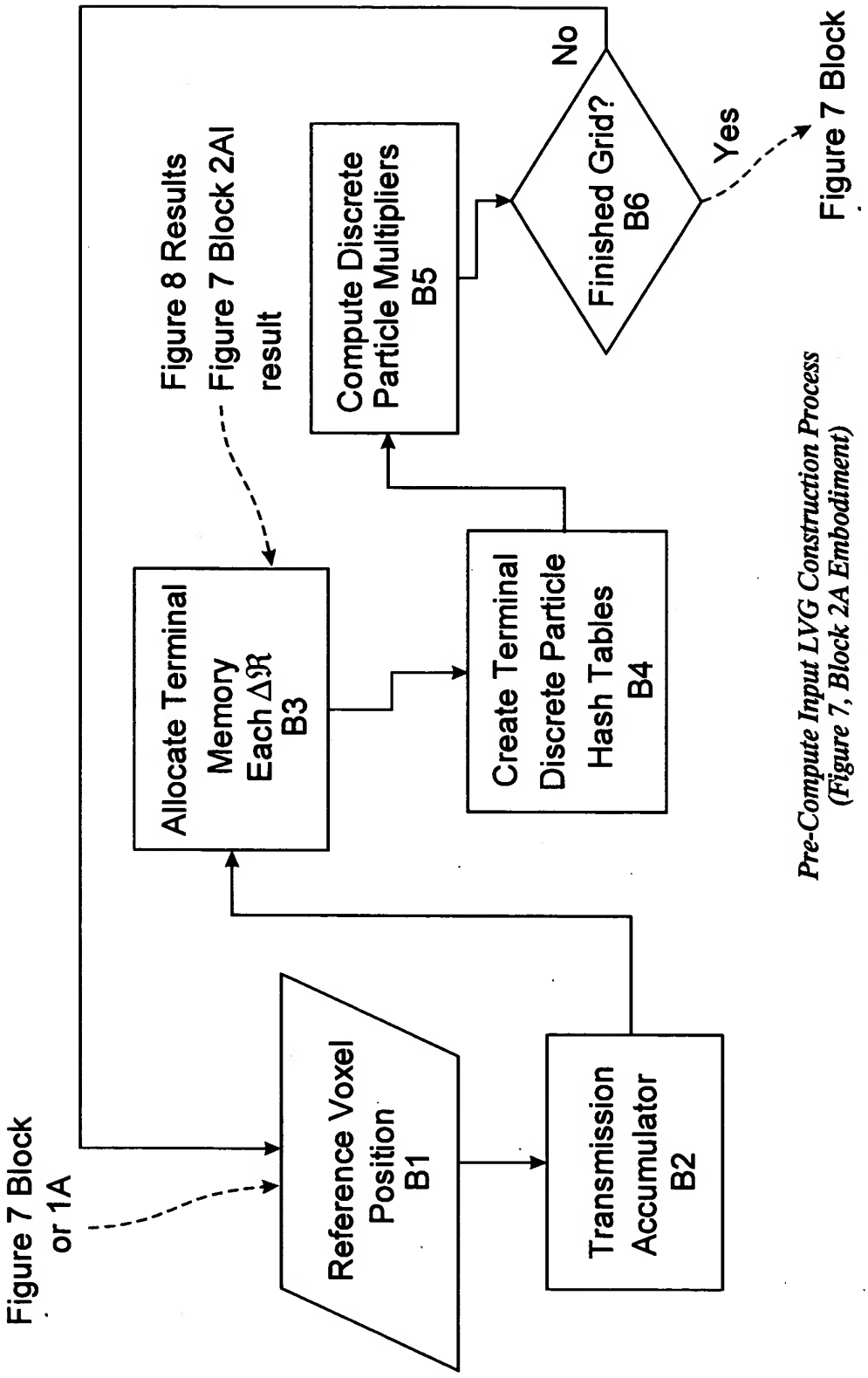
Pre-Computed Ray Set Geometric Properties (Figure 7, Block 2AI Embodiment)

Fig.8

```
1 12927 [ 0][ 0][ 0] -  10
2 [0][0][0]-336-:336-|0,4:1,2:37,2:73,2:109,4:110,2:146,2:182,1:188,4:189,2:
3 336
4 336
5 7.850558564946638e-05 6.784620633418995e+00 6.623391839641562e+00 2.819600000000000e-06
6 - [ 0][ 0][ 0] - 4 - 1.019279586938127e+00
7 - [ 0][ 0][ 1] - 2 - 9.413711183984186e-02
8 - [ 1][ 0][ 1] - 2 - 1.113416698777977e+00
9 - [ 2][ 0][ 1] - 2 - 1.113416698777977e+00
10 - [ 3][ 0][ 1] - 4 - 8.578329108772469e-02
11 - [ 3][ 0][ 2] - 2 - 1.027633407690246e+00
12 - [ 4][ 0][ 2] - 2 - 1.113416698777977e+00
13 - [ 5][ 0][ 2] - 1 - 1.205002778411613e-01
14 - [ 5][ 1][ 2] - 4 - 1.452034161741309e-01
15 - [ 5][ 1][ 3] - 2 - 8.477130047626756e-01
16 3 detail
17 0 6.659682137068683e+00 6.677133394014817e+00 6.623885099075124e+00
18   5.176445578231292e-01 - 6.677134770900707e+00
19       9.869710645786067e-01
20       1.229759582661787e-01
21      1.109947022844781e+00
22       1.109947022844781e+00
23       9.590364158782305e-02
24       1.014043381256952e+00
25       1.109947022844781e+00
26       1.418524854996891e-01
27       1.729307559421361e-01
28       7.951637814029552e-01
29  1 6.697852583372446e+00 6.730875835863125e+00 6.677135463944154e+00
30  4.295457766439909e-01 - 6.730877702159851e+00
31       1.049588508542006e+00
32      6.672025535341053e-02
33       1.116308763895405e+00
34       1.116308763895405e+00
35       8.023541120737232e-02
36       1.036073352688041e+00
37       1.116308763895405e+00
38       1.034249093947345e-01
39       1.237661683734199e-01
40       8.891176861272597e-01
41  2 6.743640693621075e+00 6.780941997558494e+00 6.730879046744218e+00
42  5.280966553287982e-02 - 6.784620633418995e+00
43       1.094353538739710e+00
44       2.958657686380297e-02
45       1.123940115603512e+00
46       1.123940115603512e+00
47       3.584565699482696e-02
48       1.088094458608688e+00
49       1.123940115603512e+00
50       4.868157770248906e-02
51       5.259631315096771e-02
52       1.022662224750057e+00
```

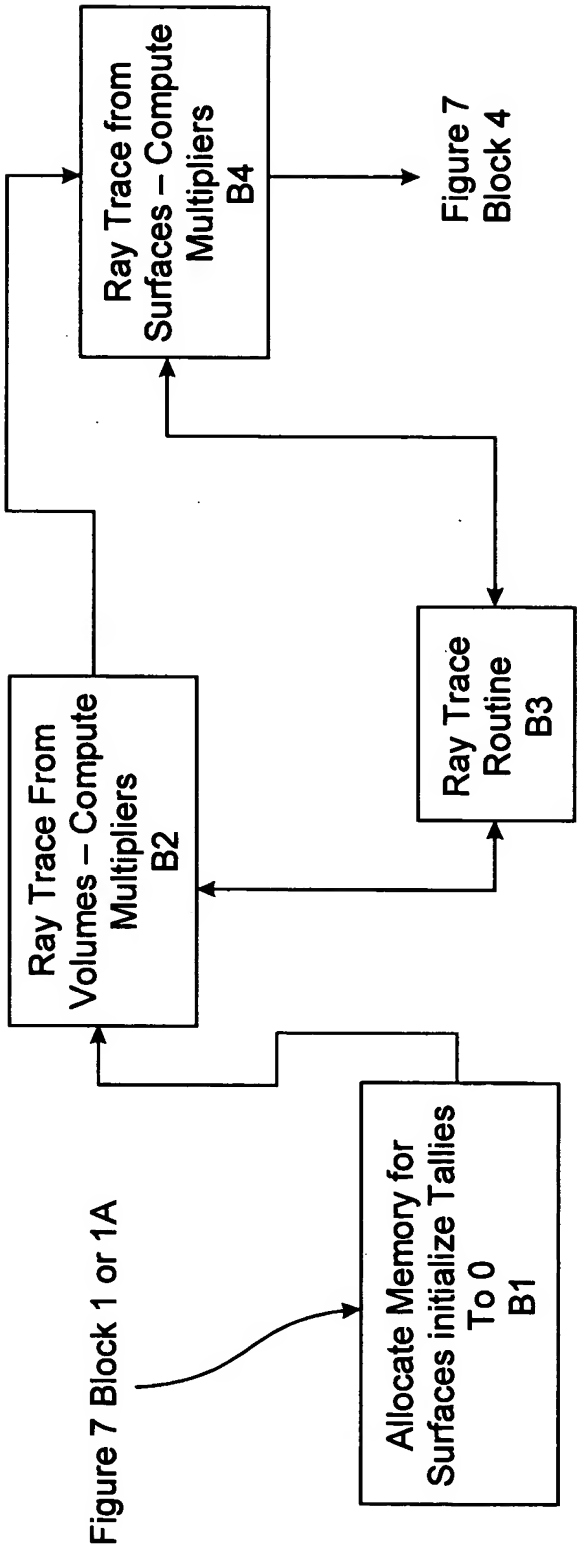
Sample Prototype Code Output Fragment from Figure 8 Pre-Computational Process

Fig.9



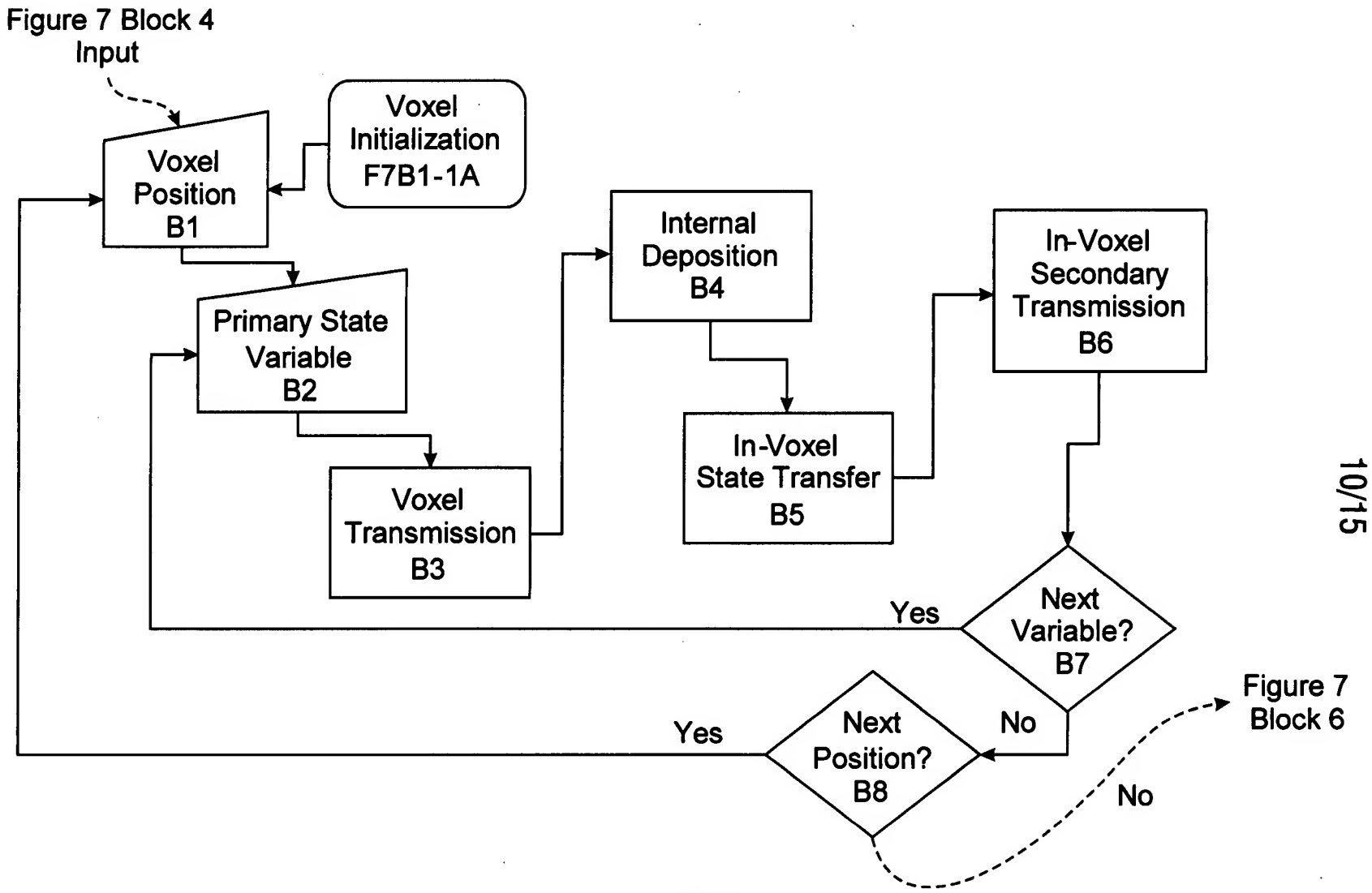
Pre-Compute Input LVG Construction Process (Figure 7, Block 2A Embodiment)

Fig.10



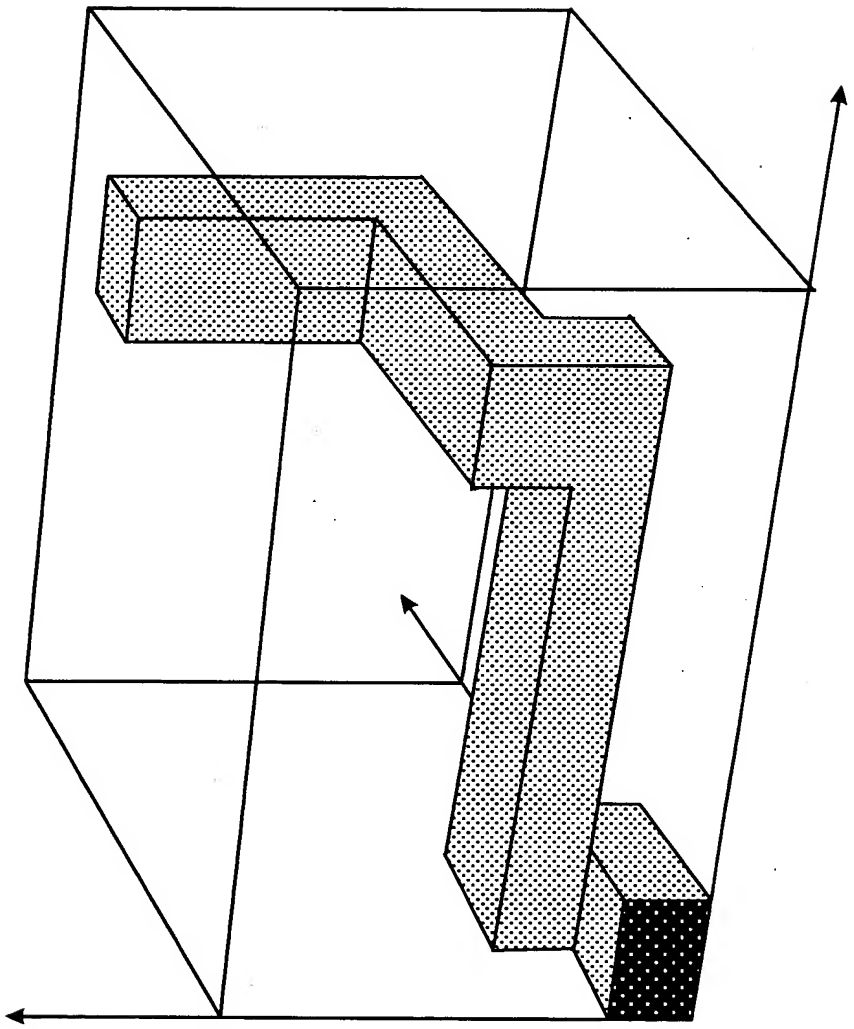
Inline Ray Set Based LVG Discrete Particle Transport Multipliers (Figure 7, Block 2 Embodiment)

Fig.11



Sample Interaction Model for Radiation
(Figure 7, Block 5 Non-Fissile Embodiment)

Fig.12



Sample Problem

Fig.13

8.3684E-04 8.4715E-04 -1.23%	6.8796E-04 6.9370E-04 -0.83%	5.8915E-04 5.9632E-04 -1.22%	4.6043E-04 4.5825E-04 0.47%	2.3168E-04 2.3132E-04 0.16%	8.4336E-05 8.3562E-05 0.92%
6.8319E-04 6.8121E-04 0.29%	5.6220E-04 5.6004E-04 0.38%	4.9065E-04 4.9042E-04 0.05%	3.9478E-04 3.8819E-04 1.67%	2.0184E-04 1.9937E-04 1.22%	7.4409E-05 7.2760E-05 2.22%
3.8524E-04 3.8161E-04 0.94%	3.1986E-04 3.1720E-04 0.83%	2.9711E-04 2.9424E-04 0.96%	2.6043E-04 2.5564E-04 1.84%	1.3899E-04 1.3739E-04 1.15%	5.2384E-05 5.1326E-05 2.02%
1.5681E-04 1.5629E-04 0.33%	1.3441E-04 1.3213E-04 1.69%	1.3593E-04 1.3582E-04 0.08%	1.4031E-04 1.3794E-04 1.69%	8.2537E-05 8.0804E-05 2.10%	**3.2430E-05** **3.1472E-05** **2.95%**
4.8680E-05 4.9014E-05 -0.69%	4.8330E-05 4.8612E-05 -0.58%	5.9359E-05 6.0540E-05 -1.99%	7.7734E-05 7.7144E-05 0.76%	0.0000E+00 0.0000E+00 0.00%	2.8368E-05 2.8356E-05 0.04%
1.4523E-05 1.4176E-05 2.39%	2.3141E-05 2.2726E-05 1.80%	4.2318E-05 4.2186E-05 0.31%	6.4404E-05 6.2589E-05 2.82%	5.8650E-05 5.7375E-05 2.17%	3.4570E-05 3.4150E-05 1.22%

Key

Monte Carlo Present Invention % Difference

Plane 4 Total Sum

7.2516E-03 7.2366E-03 0.21%

Plane 4
Planer Interaction Rate Results

Fig.14

Case	Distance	Monte Carlo (GMVP) Base Case		Present Invention		TORTE With FNSUNCL3		ARDRA P21 Solution		EVENT P9 Solution	
	(cm) x, y, z	Point Flux $cm^{-2} s^{-1}$	FSD Φ (%)	Node Avg. Flux $cm^{-2} s^{-1}$	Absolute % Error	Point Flux $cm^{-2} s^{-1}$	Absolute % Error	Point Flux $cm^{-2} s^{-1}$	Absolute % Error	Point Flux $cm^{-2} s^{-1}$	Absolute % Error
1Ai	5, 5, 5	5.9566E+00	0.000	6.0400E+00	1.40%	5.9216E+00	0.59%	5.7700E+00	3.13%	5.9670E+00	0.17%
	15, 5, 5	1.3719E+00	0.000	1.3560E+00	1.16%	1.3062E+00	4.79%	1.6300E+00	18.82%	-	-
	25, 5, 5	5.0087E-01	0.000	5.0290E-01	0.41%	4.8947E-01	2.28%	4.4600E-01	10.96%	-	-
	35, 5, 5	2.5243E-01	0.000	2.5460E-01	0.86%	2.4824E-01	1.66%	2.9200E-01	15.68%	-	-
	45, 5, 5	1.5026E-01	0.000	1.5060E-01	0.23%	1.4818E-01	1.38%	1.6000E-01	6.48%	-	-
	55, 5, 5	5.9529E-02	0.000	5.8166E-02	2.29%	5.8810E-02	1.21%	6.6900E-02	12.38%	7.0861E-02	19.04%
	65, 5, 5	1.5328E-02	0.000	1.5283E-02	0.30%	1.5165E-02	1.07%	1.7100E-02	11.56%	1.8687E-02	21.91%
	75, 5, 5	4.1769E-03	0.000	4.2170E-03	0.96%	4.1358E-03	0.98%	3.3300E-03	20.28%	5.0464E-03	20.82%
	85, 5, 5	1.1853E-03	0.000	1.2186E-03	2.81%	1.1743E-03	0.93%	7.4400E-04	37.23%	1.3882E-03	17.11%
	95, 5, 5	3.4685E-04	0.000	3.2850E-04	5.29%	3.4377E-04	0.89%	3.2200E-04	7.16%	3.8732E-04	11.67%
1Aii	5, 5, 5	8.2926E+00	0.021	8.290E+00	0.03%	8.2597E+00	0.40%	7.9400E+00	4.25%	8.2595E+00	0.40%
	15, 5, 5	1.8703E+00	0.005	1.827E+00	2.31%	1.8345E+00	1.91%	2.1800E+00	16.56%	-	-
	25, 5, 5	7.1398E-01	0.003	7.051E-01	1.24%	7.1045E-01	0.49%	6.4500E-01	9.66%	-	-
	35, 5, 5	3.8469E-01	0.004	3.692E-01	4.03%	3.6632E-01	4.77%	4.3000E-01	11.78%	-	-
	45, 5, 5	2.5398E-01	0.006	2.485E-01	2.16%	2.3171E-01	8.77%	2.6200E-01	3.16%	-	-
	55, 5, 5	1.3722E-01	0.073	1.304E-01	4.97%	1.3236E-01	3.54%	1.4600E-01	6.40%	1.5426E-01	12.42%
	65, 5, 5	4.6591E-02	0.117	4.611E-02	1.03%	4.7617E-02	2.20%	4.8400E-02	3.88%	5.3594E-02	15.03%
	75, 5, 5	1.5877E-02	0.197	1.604E-02	1.03%	1.6049E-02	1.09%	1.5400E-02	3.00%	1.8164E-02	14.41%
	85, 5, 5	5.4704E-03	0.343	5.496E-03	0.47%	5.2495E-03	4.04%	5.0800E-03	7.14%	6.1428E-03	12.29%
	95, 5, 5	1.8508E-03	0.619	1.903E-03	2.80%	1.6929E-03	8.53%	1.2400E-03	33.00%	2.0208E-03	9.19%

Kobayashi International 3D Benchmark Problem 1A Comparison

Fig.15

Case	Distance	Monte Carlo (GMVP) Base Case		Present Invention No Surface Cut		Present Invention 2x2 Surface Cut		Present Invention 2x2 6th Order Coeff.	
	(cm)	Point Flux	FSD	Node Avg. Flux	Absolute	Point Flux	Absolute	Point Flux	Absolute
	x, y, z	$cm^2 s^{-1}$	ϕ(%)	$cm^2 s^{-1}$	% Error	$cm^2 s^{-1}$	% Error	$cm^2 s^{-1}$	% Error
1Ai	5, 5, 5	5.9566E+00	0.000	6.0645E+00	1.81%				
	15, 5, 5	1.3719E+00	0.000	1.3911E+00	1.40%				
	25, 5, 5	5.0087E-01	0.000	5.0110E-01	0.05%				
	35, 5, 5	2.5243E-01	0.000	2.5332E-01	3.53%				
	45, 5, 5	1.5026E-01	0.000	1.4900E-01	0.84%				
	55, 5, 5	5.9529E-02	0.000	5.8632E-02	1.51%	5.9734E-02	0.34%	6.5482E-02	10.00%
	65, 5, 5	1.5328E-02	0.000	1.5302E-02	0.17%	1.4735E-02	3.87%	1.55421E-02	1.40%
	75, 5, 5	4.1769E-03	0.000	4.2007E-03	0.57%	4.0044E-03	4.13%	4.1066E-03	1.68%
	85, 5, 5	1.1853E-03	0.000	1.2104E-03	2.12%	1.0669E-03	9.99%	1.0993E-03	7.26%
	95, 5, 5	3.4685E-04	0.000	3.3002E-04	4.85%	3.4674E-04	0.03%	3.4294E-04	1.13%

Problem 1Ai No Scatter Surface Cut at x=50 cm

Fig.16

Problem/Method	Machine	Process Time (sec)
Present Invention 1Ai	Pentium Xeon 2.2 GHz 32 bit	236 Setup 0.01 Exec
Present Invention 1Ai Cut	Pentium Xeon 2.2 GHz 32 bit	163 / 0.021
Present Invention 1Ai Coeff	Pentium Xeon 2.2 GHz 32 bit	120/ 1.798
Present Invention 1Aii	Pentium Xeon 2.2 GHz 32 bit	4996 / 33.34
TORT FNSUNCL3 1Ai	FUJITSU AP3000/24 - 296 MHz	9944
TORT FNSUNCL3 1Aii	FUJITSU AP3000/24 - 296 MHz	12781
GMVP Base 1Ai	FUJITSU VPP500 100MHz	1440
GMVP Base 1Aii	FUJITSU VPP500 100MHz	378,000
ARDRA 1Ai	IBM ASCI Blue-Pacific	7847
ARDRA 1Aii	IBM ASCI Blue-Pacific	10223
EVENT 1Ai	AXP1000 667 MHz Alpha	6344
EVENT 1Aii	AXP1000 667 MHz Alpha	8357

Time Comparison of Present Invention Problem 1Ai and 1Aii

Fig.17